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NOTES ON GEOGRAPHIC DISTRIBUTION

Primates, Pitheciidae, *Callicebus barbarabrownae* Hershkovitz, 1990: New localities for the critically endangered titi monkey in the São Francisco basin, state of Sergipe, Brazil

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ABSTRACT: Barbara Brown's titi monkey, *Callicebus barbarabrownae* Hershkovitz, 1990, appears to be endemic to the Caatinga of northern Bahia and western Sergipe, although few data are available for the northernmost portion of its range. The present study presents seven new occurrence records of the species, in the São Francisco basin of northern Sergipe, extending its range in the state over a distance of more than 50 km from west to east. This represents an important extension of the known range and total number of populations of this critically endangered primate species.

Barbara Brown's titi monkey, *Callicebus barbarabrownae* Hershkovitz, 1990, was originally recorded from Lamarão in the Brazilian state of Bahia (see Hershkovitz 1990), although the first systematic geographic survey was conducted some 20 years later (Printes *et al*. 2011), and little was known of its distribution in the neighboring state of Sergipe prior to the present study. The species appears to be restricted to semi-arid arboreal Caatinga habitats (Marinho-Filho and Veríssimo 1997; Kobayashi and Langguth 1999; Printes *et al*. 2011), a fact that contributes to its classification as critically endangered by the IUCN (Veiga *et al*. 2008) due primarily to habitat loss and fragmentation, given that more the 40% of this biome is degraded (Castelletti *et al*. 2003) and less than 1% is protected (Leal *et al*. 2005), which has a direct effect on the number of populations surviving in the wild.

In the present study, the Caatinga of the São Francisco basin in the northern extreme of the state of Sergipe (Figure 1) was surveyed systematically for the identification of new populations of titis. The São Francisco River forms the northern limit of the genus *Callicebus* (*personatus* species group) in eastern Brazil (Hershkovitz, 1990). The primary aim was to locate all the populations remaining in the Caatinga domain, as defined by IBGE (2004), within the area demarcated for the study, in order to provide a database for the estimation of metapopulation parameters. The study area comprises the municipalities of Graccho Cardoso (10°13' S, 37°11' W), in the south, and Canindé do São Francisco (9°39' S, 37°47' W) in the north, and represents the highest part of the state, the *Sertão* plateau, with altitudes reaching a maximum of 715 m a.s.l. in the Serra da Guia (9°57' S, 37°52' W). The region's climate is typical of the Caatinga – hot, semi-arid (Köppen's BSsh' type) – with a mean annual precipitation of approximately 550 mm, and a mean temperature of around 26 °C.

In the first phase of the survey, forest fragments were selected through the visual interpretation of recent satellite images (LandSat 5 images from 2006) of the study area, which permitted the identification and mapping of potential sites for the occurrence of *C. barbarabrownae* within the study area. Only fragments with a minimum area of 20 hectares were included in the analysis, as this represents the approximate lower limit of home range size in *Callicebus* species (Bicca-Marques & Heymann in press). During fieldwork at some sites, however, smaller fragments were surveyed whenever the presence of titis was indicated by local residents.

During the second (field) phase, the presence of *Callicebus* at the sites identified in the first phase was evaluated through the use of playback surveys, in which recordings of the territorial vocalizations of the genus were broadcast through a megaphone (CSR Hmp 1503; 20w) in order to elicit a response from titi groups within auditory range. Titis will normally react incisively to the potential presence of conspecific intruders by vocalizing and advancing in the direction of the source. Playbacks have been used successfully in a number of surveys of *Callicebus* populations (Rowe & Martinez 2003; Jerusalinsky *et al*. 2006; Martinez & Wallace 2007; Aldrich *et al*. 2008; Printes *et al.* 2011).

In the field, fragments identified by local residents were visited and surveyed by carefully walking along existing trails at the edge and interior of the forest, and broadcasting the playback at 15-minute intervals. Surveys were conducted between 06:00-09:00 h and 15:00-17:00 h, when titis are normally more responsive to the playbacks (Melo and Mendes 2000; Soares *et al*. 2011). When no response was obtained during the initial survey,

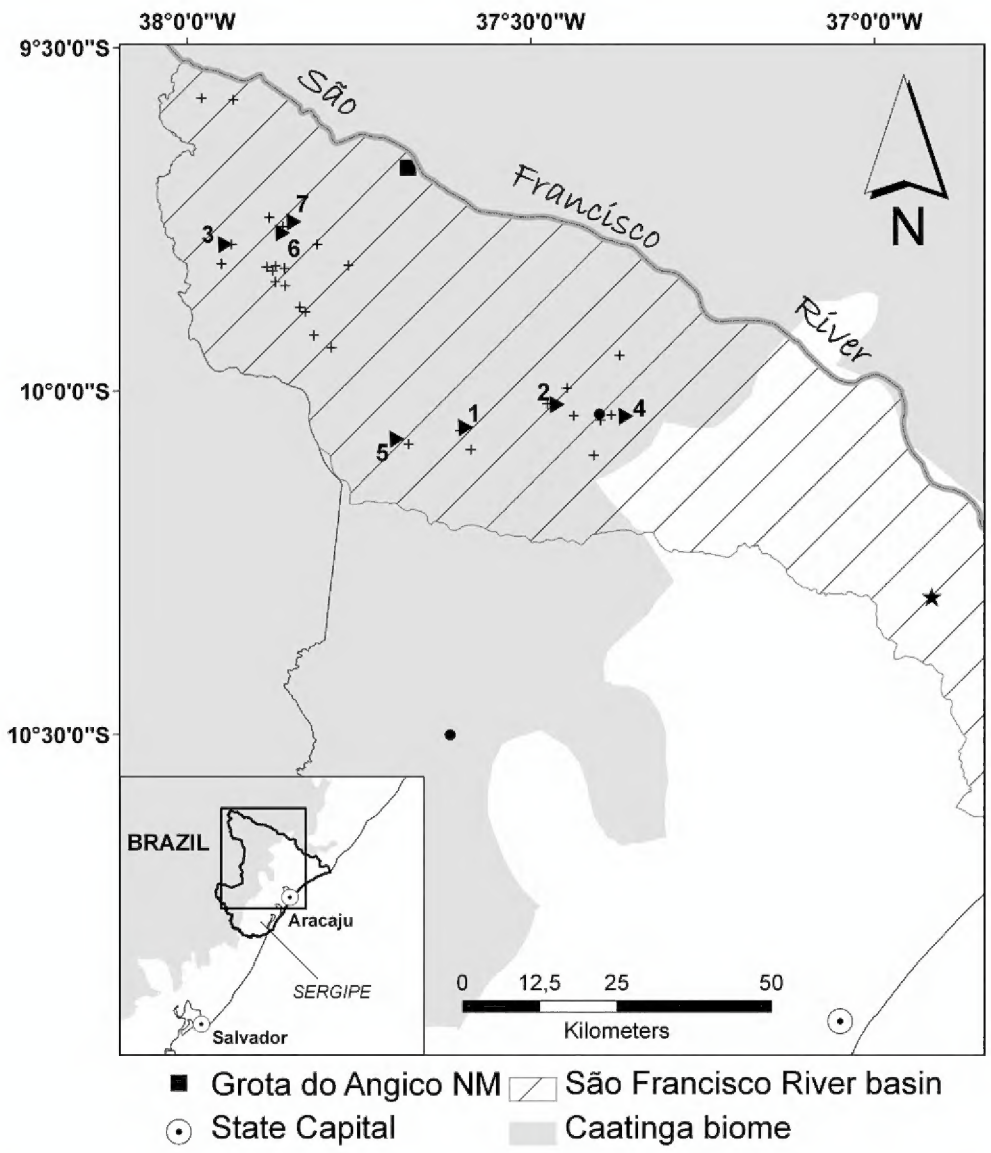

FIGURE 1. Map of the São Francisco basin in northern Sergipe, showing the sites surveyed during the present study (▲ = *Callicebus barbarabrownae* recorded; + = *C. barbarabrownae* not found), localities at which *C. barbarabrownae* (●) was recorded in previous studies (Sousa 2003; Jerusalinsky et al. 2006) and the nearest site at which *Callicebus coimbrai* was recorded in the São Francisco basin ( ) by Beltrão-Mendes (2010) and Santos Junior (2010). The sites are numbered as in Table 1.

the site was resurveyed on subsequent days following the same procedure until either the presence of *Callicebus* was confirmed or the site had been surveyed on four separate occasions, when fieldwork was interrupted and the site was recorded as not having a population of titis. When a response was obtained, efforts were made to visualize the animals, and verify the minimum number of groups within the area, based on simultaneous responses to playbacks or observations in different areas of the forest.

A total of 36 localities were visited within the study area between October, 2008, and May, 2010. The presence of titi monkeys was confirmed at seven of these sites (Table 1). Monkeys were observed directly at only three of these sites (1, 4, and 5), although their characteristic vocalization is an unmistakable sign of the presence of the genus. For sites at which the animals were not observed directly, the species was identified as *C. barbarabrownae* based on the fact that this is the only member of the genus that occurs in the Caatinga, and that all sites were within the general area of the geographic range of the species, as defined by Printes *et al.* (2011). The only other member of the genus found in Sergipe is *C. coimbrai*, which is restricted to the Atlantic Forest ecosystems in the eastern and southern extremes of the state (Kobayashi and Langguth 1999; Jerusalinsky *et al.* 2006). The species can be distinguished by the predominantly buffy coloration of *C. barbarabrownae*, primarily on the forehead, crown, trunk, and limbs, with paler subterminal pheomelanic banding of the hairs (van Roosmalen *et al.*, 2002). The nearest known record of *C. coimbrai* in the São Francisco basin of Sergipe (Marques *et al.* in press.) is more than 50 km south of the southernmost *C. barbarabrownae* locality recorded in the present study (Figure 1).

Site 1: Fazenda "Tonho"

Very small and highly degraded fragment of arboreal Caatinga habitat surrounded by pasture, and used by the local population as a source of firewood, which poses a grave threat to the long-term survival of the forest.

Site 2: Fazenda João de Lima

Fragment of hyperxerophilous arboreal Caatinga. Habitat at an advanced stage of succession, with a relatively tall canopy of up to 10 m in height located within a matrix of pasture. The principal threat is the extraction of firewood.

Site 3: Fazenda Paturi

Fragment of hyperxerophilous arboreal Caatinga at an intermediate stage of succession. The fragment is surrounded by pasture, and the primary threat to the habitat appears to be incursions by cattle, which may be suppressing the recruitment of seedlings in many areas. Evidence was also found of the extraction of firewood, such as recently-cut tree stumps, and hunting (baiting platforms) within the area of the fragment.

Site 4: Mata do Enoc

Very small fragment of hyperxerophilous arboreal Caatinga at an advanced stage of degradation, similar to that of site 1. The fragment is located within a matrix of pasture and subsistence plots, and its primary threat is its isolation (over 10 km from the nearest area of natural habitat with known population – site 2).

Site 5: Assentamento Raimundo Monteiro

Relatively large, but poorly-preserved fragment of arboreal Caatinga. The central portion of the fragment is characterized by dense undergrowth reflecting intense anthropogenic pressure, although some portions of the forest are at an intermediate stage of succession. The fragment is surrounded by pasture and numerous subsistence plots, many of which are expanding illegally, thus constituting the major threat to the fragment.

Sites 6 and 7: Serra Azul and Serra da Beleza

Two medium-sized fragments of arboreal Caatinga located close to one another, but in distinct municipalities. These fragments form the forest reserve of the Projeto de Assentamento José Pedro Teixeira, an agricultural settlement. Located on hilltops, the fragments are extensively degraded, even though the habitat is at an intermediate successional stage. The surrounding matrix is formed by pastures and subsistence plots. Part of the remaining habitat was encroached by an uncontrolled burn-off of agricultural land in 2005.

The present study represents an important advance in our knowledge of the geographic distribution of the critically endangered *C. barbarabrownae* in the Brazilian Northeast, but the results also serve to reinforce the generally precarious circumstances of most of the remaining populations. While a total area of 955.5 ha was identified, only three fragments were over 100 ha in

area, all of which are degraded and suffer some form of ongoing anthropogenic impact. In addition, only seven of the 36 sites (19.4 %) surveyed contained populations of *C. barbarabrownae*. As populations were observed in very small fragments, of less than 10 ha, the absence of the species from a given site appears to be related to factors other than fragment size *per se*. Given the dynamics of *Callicebus* populations in fragmented landscapes (Jerusalinsky *et al.* 2006), the critical factor for the survival of populations may be the distance between fragments. Within the area of the present study, most large fragments are separated by distances of a number of kilometers, which are prohibitive for the effective dispersal of titis. The most serious threat to all these populations may nevertheless be the lack of official protection, not least because the only officially protected area in northern Sergipe – the Grota do Angico Natural Monument in Poço Redondo – does not contain a population of *C. barbarabrownae*. The long-term survival of this species will ultimately depend on the development of an effective program of metapopulation management.

Table 1. Details of the sites at which *Callicebus barbarabrownae* populations were recorded in the Caatinga of the São Francisco basin in northern Sergipe, Brazil.

SITE	LOCALITY	MUNICIPALITY	GEOGRAPHIC COORDINATES	ALTITUDE (M)	FRAGMENT SIZE (HA)	DISTANCE TO NEAREST FRAGMENT (KM)
1	Fazenda 'Tonho"	Monte Alegre de Sergipe	10°03' S, 37°36' W	228	2.3	0.5
2	Fazenda João de Lima	Porto da Folha	10°01' S, 37°28' W	253	163.0	0.8
3	Fazenda Paturi	Canindé do São Francisco	9°47' S, 37°57' W	305	266.0	0.5
4	Mata do Enoc	Porto da Folha	10°02' S, 37°22' W	135	3.0	0.8
5	Assentamento Raimundo Monteiro	Monte Alegre de Sergipe	10°04' S, 37°42' W	268	381.0	3.8
6	Serra Azul	Canindé do São Francisco	9°46' S, 37°52' W	330	42.5	1.0
7	Serra da Beleza	Poço Redondo	9°45' S, 37°51' W	306	97.7	1.0

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ERRATUM

In page 114 there is a mistake in the legend of Figure 1, which should be as:

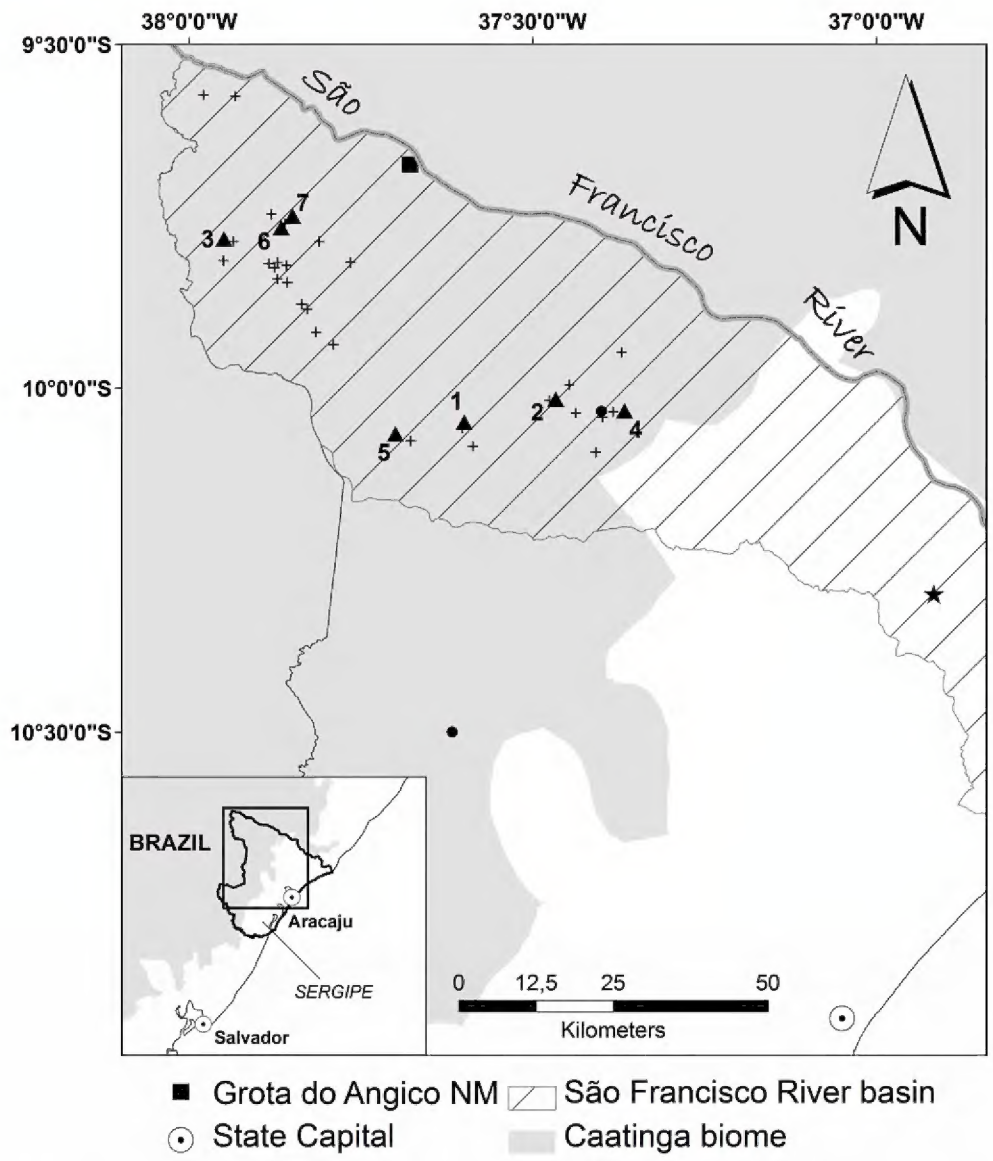

FIGURE 1. Map of the São Francisco basin in northern Sergipe, showing the sites surveyed during the present study (▲ = *Callicebus barbarabrownae* recorded; + = *C. barbarabrownae* not found), localities at which C. barbarabrownae (●) was recorded in previous studies (Sousa 2003; Jerusalinsky et al. 2006) and the nearest site at which *Callicebus coimbrai* was recorded in the São Francisco basin (★) by Marques *et al.* (in press.). The sites are numbered as in Table 1.

We regret this error.

The authors,

April 2013